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U1S S1405 S1700 S1707 S1708 S1739 S3011

(56) Documents Cited
GB 1386347 A EP 0154452 A2

(58) Field of Search
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ONLINE:WPI,EPODOC,JAPIO

(54) Abstract Title
Manufacturing a composite insulating panel

(57) A composite insulating panel comprises an external metal skin (1), an internal metal skin (2) and an insulating core (3) of phenolic foam between the skins (1,2). The panels are manufactured by first conveying one of the metal skins (1) continuously along a flat bed (30), pre-treating at least a portion of the first skin, laying down liquid phenolic insulating foam reactants onto the first skin through a lay-down device such as a poker (35), pre-treating at least a portion of the second skin (2), leading the second metal skin (2) continuously over the liquid foam insulating foam reactants and the first metal skin (1), heating the assembly in an oven to allow the reactants to expand to form an insulating core, heating the marginal edges of the panel and cutting the panel to a desired length. The pretreatment may be heating such as by IR lamps (45) and/or application of adhesive. A coating such as a primer may be applied to one or both of the skins prior to lay-down of the foam reactants. The skins may be spaced apart by spacer blocks. A sealing tape may be applied to a panel edge after cutting.

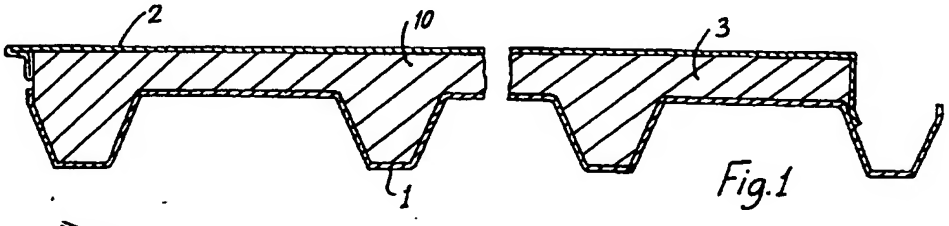

Fig.1

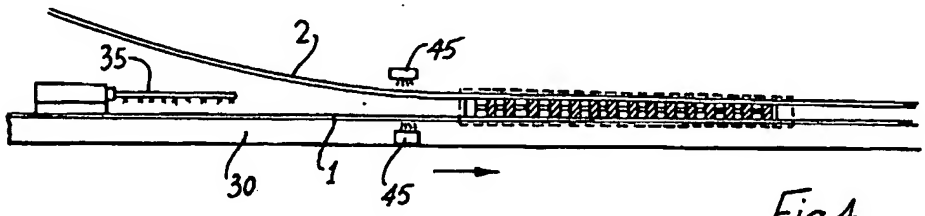

Fig.4

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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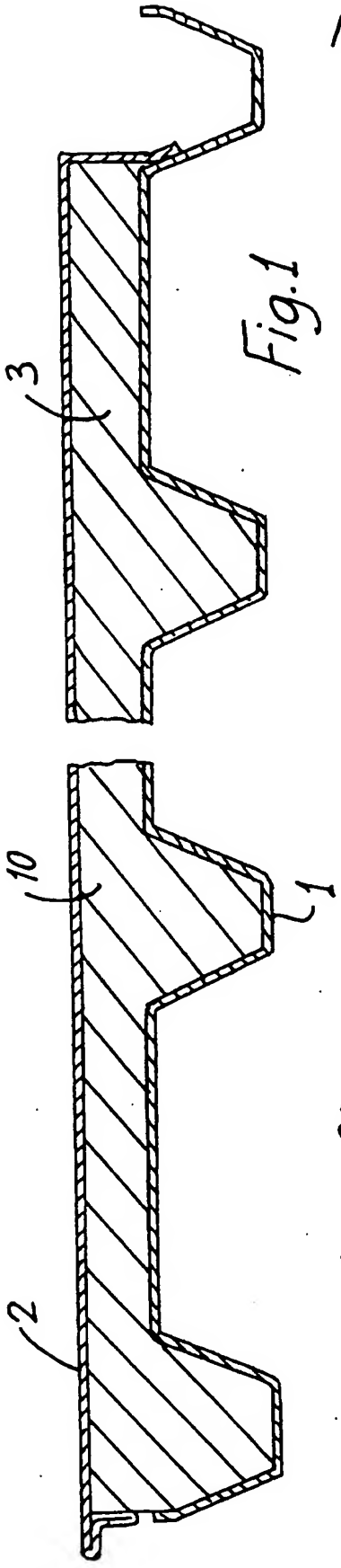

Fig.1

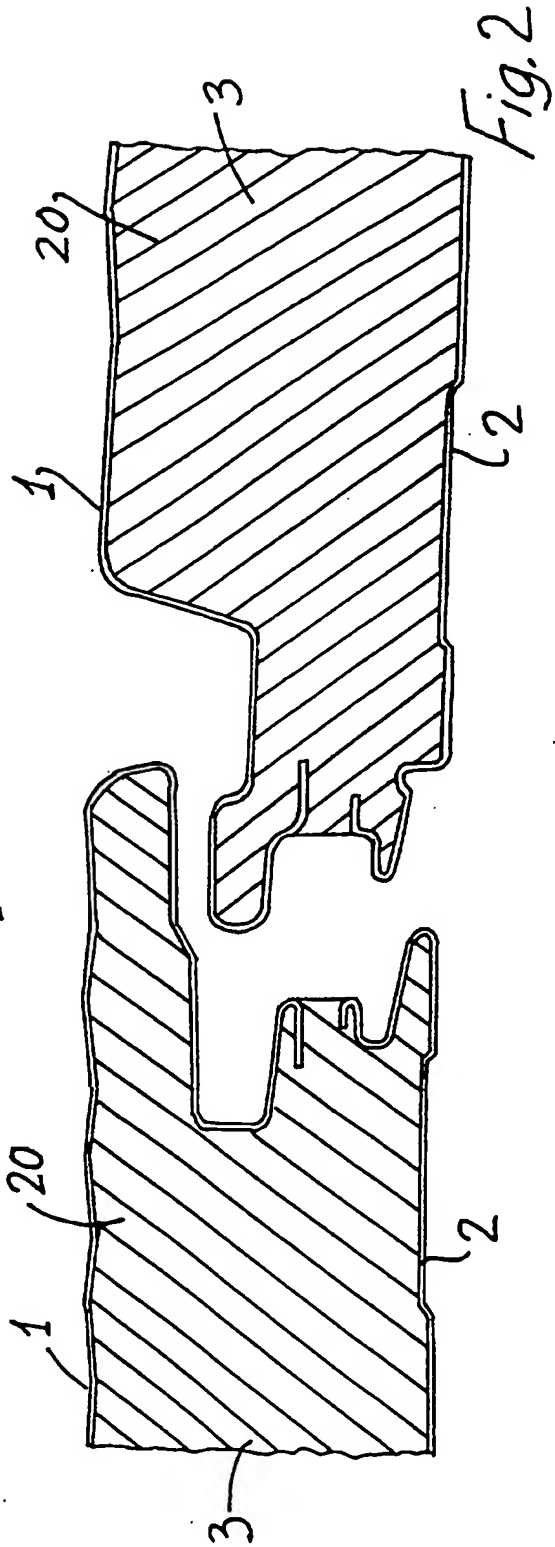

Fig.2

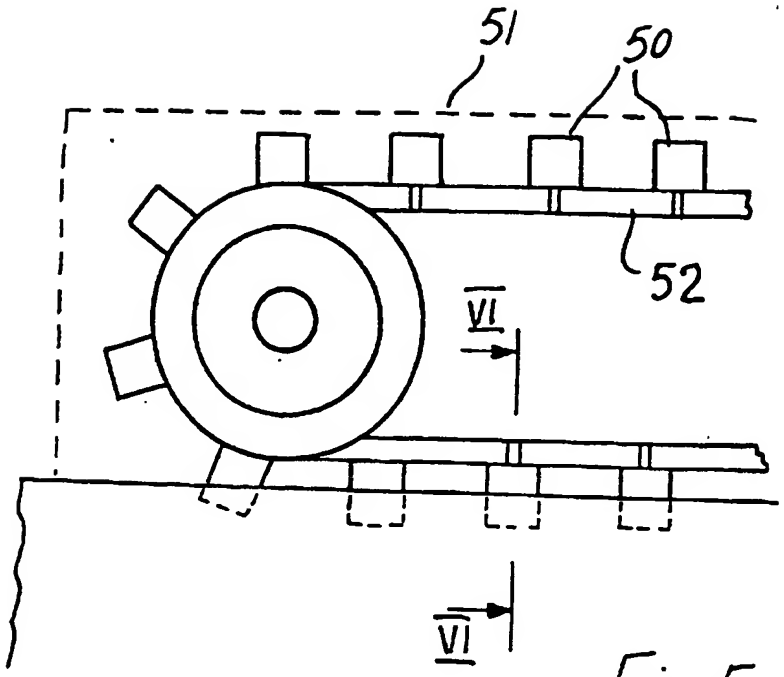

Fig. 5

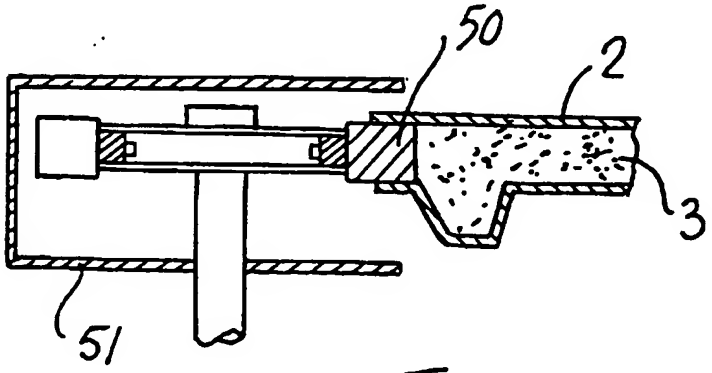

Fig. 6

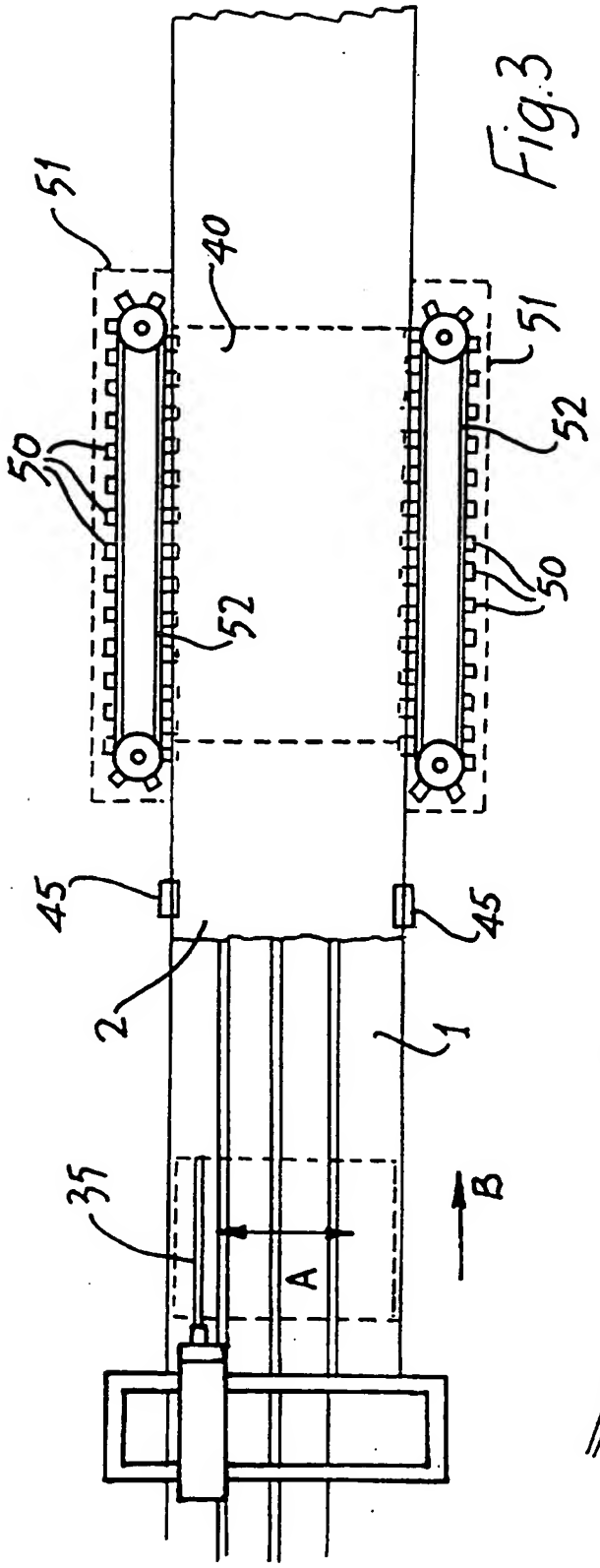

Fig.3

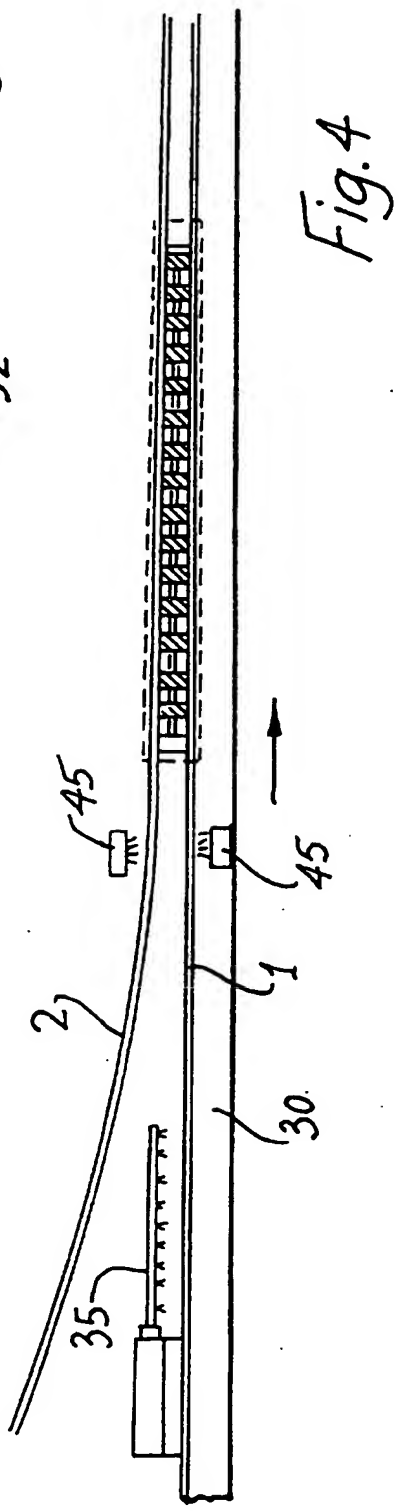

Fig.4

"A PANEL"

Introduction

The invention relates to a panel of the type comprising an external sheet and a backing sheet with an insulating foam core therebetween.

It is known to provide an insulated panel of this type with a foam core of phenolic material which has a high level of fire resistance and may be used in a wide range of structural applications.

GB 1386347 describes a process for producing sheets of phenolic resin foam. It is suggested that the faces of upper and lower layers which may come into contact with the foam mixture be coated with an adhesive.

EP-A-154452 describes a process for producing phenolic foam laminates which includes applying pressure on the foam-forming mixture through one of its facings using a flexible member.

US 3821337 describes a process for preparing a foamed phenol-aldehyde insulating board in which a specific foam formulation, after curing, is passed through a microwave resonance cavity.

There is however a need for a factory scale process for producing a phenolic foam panel substantially continuously at high production rates while substantially eliminating defects such as delamination and/or voids in the foam structure.

In particular there is a need to produce such insulated panels on an economic scale for use in a wide range of dimensions, applications, facings, coatings and finishes.

This invention is directed towards providing such a process of manufacture.

Statements of Invention

A method for manufacturing a composite insulating panel of the type comprising an external metal skin, an internal metal skin and an insulating core of phenolic foam material therebetween, the method comprising the steps of:-

conveying one of the metal skins continuously along a flat bed with an outer surface of the skin lowermost;

pre-treating at least portion of the first skin;

laying down liquid phenolic insulating foam reactants onto the first skin;

pre-treating at least portion of the second skin;

leading the second metal skin continuously over the liquid insulating foam reactants and the first metal skin;

heating the assembly in an oven to allow the phenolic foam reactants to expand to form an insulating core between the metal skins;

heating the marginal edges of the panel; and

cutting the panel to a desired length.

In a preferred embodiment the pre-treating of one or both skins includes the step of heating at least portion of one of the skins prior to, during, and/or after lay down of the liquid phenolic insulating foam reactants.

The pre-treating may alternatively or additionally comprise applying an adhesive means to at least portion of the insulating core engaging face of one or both skins.

The adhesive means may be applied in the form of a membrane or tape. Typically the adhesive means is a laminate.

Alternatively or additionally the adhesive is curable in-situ.

The adhesive may be a polyurethane based adhesive.

Ideally the marginal edges of the panel are treated just before, during and/or just after formation of the panel.

In a preferred embodiment of the invention spacer blocks are provided between the skins at the side marginal edges thereof, on assembly, and the method includes the step of heating the spacer blocks. The spacer blocks may be heated by leading the blocks through an oven.

In another embodiment of the invention the method includes the step of applying a coating to one or both of the skins prior to lay-down of the liquid phenolic foam reactants.

The coating is a primer material which preferably chemically reacts with the curing foam for improved bonding of the foam to the skin(s).

The coating may be applied continuously in-line.

In one embodiment of the invention the method includes the step of sealing the cut edge of the panel, after cutting.

Preferably a sealing tape is applied to the cut-edge.

In a preferred embodiment of the invention the method includes the step of maintaining the cut panels in an environment at a temperature of at least 30°C for a period of at least 24 hours, after foaming.

In one embodiment of the invention the cut panels are stacked and the stack is covered with a layer of plastics material for storage.

The invention also provides composite insulating panel whenever manufactured by a method of the invention.

Description of Drawings

The invention will be more clearly understood from the following description thereof given by way of example only with reference to the accompanying drawings, in which :-

Fig. 1 is a transverse cross sectional view of one type of panel manufactured by the method of the invention;

Fig. 2 is a transverse cross sectional view of another type of panel manufactured by the method of the invention;

Fig. 3 is a plan view of part of an apparatus used in the method of the invention;

Fig. 4 is a side view of the apparatus of Fig. 3;

Fig. 5 is a plan view of a detail of the apparatus of Fig. 3; and

Fig. 6 is a cross sectional view on the line VI – VI of Fig. 5.

Detailed Description

Referring to the drawings and initially to Figs 1 and 2 thereof a composite insulating panel comprises an external metal skin 1, an internal metal skin 2, and an insulating core 3 of phenolic foam between the skins 1,2. Both skins 1,2 may be of steel material and are usually profiled to a desired profile shape. The insulated panel is typically used for roofing and/or wall cladding, partitions, compartmental wall panels, cold store panels, clean room envelopes, food processing areas and the like applications, particularly where added fire resistance is required.

A typical roof panel 10 is illustrated in Fig. 1. A number of such panels 10 are overlapped longitudinally and transversely to cover a roof area.

Portion of a wall panel 20 is illustrated in Fig. 2 which shows a detail of a joint between adjacent wall panels 20. Such a panel is described in detail in WO 9853155 A.

The insulating panels are manufactured by first conveying one of the metal skins 1 continuously along a flat bed 30 with an outer surface of the skin 1 lowermost. Liquid phenolic insulating foam reactants are then laid down through a lay down device such as a poker 35 onto the first skin 1. The second skin 2 is laid continuously over the liquid insulating foam reactants and the first metal skin 1. The assembly thus formed is then heated in an oven 40 to allow the phenolic foam reactants to expand to form an insulating core 3 between the metal skins 1,2. The continuous panel thus formed is then cut to a desired length.

The foam-receiving faces of one and preferably both metal skins are pre-treated to assist in the adhesion of the phenolic foam to the skins. A coating may be applied to the reels of the metal, prior to profiling or after profiling, preferably both. The coating may be a primer material which includes phenolic foam compatible

adhesives to provide adhesion between the phenolic foam and the facing. The adhesive is preferably a material that has a chemical reaction with the curing foam. Such an adhesive may be polyurethane based.

Alternatively or additionally an adhesive means in the form of a membrane or tape may be applied to the foam-engaging faces of one or both skins. The membrane or tape may be in the form of a laminate. One such laminate may consist of a non-woven polyester coated with an adhesive to provide a surface key. The product may be laminated in-line prior to forming. One such product is METABOND (Trade Mark) of Carless Tapes, Birmingham.

The reactants are laid down onto the first skin from a preparation plant which delivers the reactants to the lay-down poker 35 which extends longitudinally above the skin and has a plurality of spaced-apart outlets through which the reactants are delivered. The poker is moved transversely across the skin in the direction of the arrows A as the skin is continuously moved along the lay down bed in the direction of the arrow B to achieve an even spread of the phenolic reactants across the length and width of the skin 1.

Ideally at least portion of one, and preferably both skins are heated just prior to, during and/or after lay down of the liquid phenolic foam reactants. The preheating may, for example be achieved by direct in-line heating using IR lamps 45 or the like. The heat is preferably directed at least at the side edges of the foam receiving faces of the skins. Indeed, heat may be used to activate the coating material applied to one or both skins to assist in foam adhesion. Ideally the facings are heated to a surface temperature of 30 to 50°C immediately prior to lay down.

The skins 1,2 are spaced-apart by spacer blocks 50 which maintain the skins at a desired spacing corresponding to a desired panel thickness, after the skins 1,2 are assembled. The skins 1,2 with the foam reactants laid down therebetween are led

through the oven 40 in which the foam rises to fill the space between the skins 1,2. To assist the uniform foam expansion the skins may also be locally heated, especially at the side marginal edges. The spacer blocks 50 are preferably heated as these engage both side marginal edges of both skins 1, 2, during foam expansion. The spacer blocks 50 may, for example, be heated by passing the blocks through a tunnel heater 51 just before they engage the skins. Such blocks 50 may be carried on an endless chain 52 so that the blocks 50 move with the panel as it passes through the oven 40. The spacer blocks 50 may be heated to a greater or lesser temperature than that of the main oven 40 and typically to achieve a skin surface temperature of 40 to 60°C.

The formed panels are then cut to a desired length using an in-line saw. The cut edge of the panel is sealed to provide a uniform environment within the panel as the foam continues to cure. The sealing may be by way of a tape which is continually applied to the cut edge of the panel.

After cutting, the panels are stacked and then immediately transferred to a controlled environment at a temperature of at least 30°C. The panels are maintained in this environment for a period of from 24 to 48 hours until the curing of the phenolic foam is complete.

The phenolic panels thus produced have excellent structural aesthetic, thermal, acoustic and fire resistant properties. They may be readily produced in any desired length, width or thickness.

Example

Formulations and run Conditions

	Run 1	Run 2	Run 3
Formulation (pbw)			
Phenolic Resin	100	100	100
HCFC141b	7	7	7
50% Sulphuric Acid	17.5	20.8	-
81% Phosphoric Acid	3.5	4.2	4
65% Phenol Sulphonic Acid	-	-	16
Panel thickness (mm)	45	80	45
Chemical output (kg/min)	10.5	13.7	8.8
Line Speed (m/min)	3.5	2.5	3.6
Resin blend temperature (deg C)	25	25	25
Acid blend temperature (deg C)	20	20	25
Press temperature (deg C)	50	50	50

Foam properties for Runs 1 and 2

Density Results

Sample No.	**Run 1 45 mm (Kg/M)**	**Run 2 80 mm (Kg/M)**
1 (Male)	60.77	57.77
2	52.54	57.73
3	59.63	57.24
4	59.04	52.2
5	59.38	58.14
6	59.25	57.25
7	59.86	56.53
8	58.89	56.29
9	61.83	57.65
10 (Female)	60.57	55.63
Average	59.176	57.243

Thermal Conductivity

Run 1, 45 mm	0.018 W/mK
Run 2, 80mm	0.019 W/mK

Strength Properties

Run 1 45mm	Tensile Strength	Tensile Modulus	Comp. Strength	Comp. Modulus	Shear Strength	Shear Modulus
1	0.03	1.33	0.14	6.51	0.07	3.58
2	0.05	1.28	0.15	7.25	0.06	3.38
3	0.04	1.14	0.14	5.73	0.077	3.48
4			0.13	6.26		
5			0.12	3.97		
Average	0.04	1.25	0.136	5.94	0.069	3.48

Run 2 80mm	Tensile Strength	Tensile Modulus	Comp. Strength	Comp. Modulus	Shear Strength	Shear Modulus
1	0.07	2.74	0.13	4.99	0.07	3.6
2	0.03	2.32	0.13	5.79	0.07	3.55
3	0.05	2.67	0.12	6.37	0.06	3.45
4	0.05	3.95	0.13	6.55		
5			0.13	6.96		
Average	0.05	2.92	0.128	6.13	0.0666667	3.53

The invention provides an extremely efficient factory scale process for manufacturing high quality composite phenolic foam panels on a continuous basis. Thus, the unit costs of production of such panels is minimised.

The invention is not limited to the embodiments hereinbefore described which may be varied in detail.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

Claims

1. A method for manufacturing a composite insulating panel of the type comprising an external metal skin, an internal metal skin and an insulating core of phenolic foam material therebetween, the method comprising the steps of:-

conveying one of the metal skins continuously along a flat bed with an outer surface of the skin lowermost;

pre-treating at least portion of the first skin;

laying down liquid phenolic insulating foam reactants onto the first skin;

pre-treating at least portion of the second skin;

leading the second metal skin continuously over the liquid insulating foam reactants and the first metal skin;

heating the assembly in an oven to allow the phenolic foam reactants to expand to form an insulating core between the metal skins;

heating the marginal edges of the panel; and

cutting the panel to a desired length.

2. A method as claimed in claim 1 wherein the pre-treating of one or both skins includes the step of heating at least portion of one of the skins prior to, during, and/or after lay down of the liquid phenolic insulating foam reactants.

3. A method as claimed in claim 1 or 2 wherein the pre-treating comprises applying an adhesive means to at least portion of the insulating core engaging face of one or both skins.

4. A method as claimed in claim 3 wherein the adhesive means is applied as a membrane or tape.

5. A method as claimed in claim 4 wherein the adhesive means is a laminate.

6. A method as claimed in any of claims 3 to 5 wherein the adhesive is curable in-situ.

7. A method as claimed in any preceding claim wherein the adhesive is a polyurethane based adhesive.

8. A method as claimed in any preceding claim wherein the marginal edges of the panel are treated just before, during and/or just after formation of the panel.

9. A method as claimed in claim 8 wherein spacer blocks are provided between the skins at the side marginal edges thereof, on assembly, and the marginal edges of the panel are treated by heating the spacer blocks.

10. A method as claimed in claim 9 wherein the spacer blocks are heated by leading the blocks through an oven.

11. A method as claimed in any preceding claim wherein the pre-treatment comprises applying a coating to one or both of the skins prior to lay-down of the liquid phenolic foam reactants.

12. A method as claimed in claim 11 wherein the coating is a primer material.

13. A method as claimed in claim 11 or 12 wherein the coating is applied continuously in-line.

14. A method as claimed in any preceding claim including the step of sealing the cut edge of the panel, after cutting.

15. A method as claimed in claim 14 wherein a sealing tape is applied to the cut-edge.

16. A method as claimed in any preceding claim including the step of maintaining the cut panels in an environment at a temperature of at least 30°C for a period of at least 24 hours, after forming.

17. A method as claimed in claim 16 wherein the cut panels are stacked and the stack is covered for storage.

18. A method as claimed in claim 17 wherein the stack is covered with a layer of plastic material.

19. A method for manufacturing an insulating panel substantially as hereinbefore described.

20. An insulating panel whenever manufactured by a method as claimed in any preceding claim.

21. A method of manufacturing a composite insulation panel including any novel step or novel combination of steps as disclosed in the specification and/or illustrated in the accompanying drawings.

22. An insulation panel including any novel feature or novel combination of features as disclosed herein and/or illustrated in the accompanying drawings.

The Patent Office

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Application No:	GB 9926661.1	**Examiner:**	R.J.MIRAMS
Claims searched:	1 to 20	**Date of search:**	28 February 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): B5N

Int Cl (Ed.7): B29C 44/32. B32B5/20, 3100, 31/06. E04C 2/292.

Other: ONLINE: WPI, EPODOC, JAPIO.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB1386347A	(Dynamit Nobel)	
A	EP0154452A2	(BP Chemicals)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.